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The Effects of Disease Contamination on Memory for Touched Objects in Older Adults

By

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Abstract

Recently it has been shown that individuals have better memory for objects that have been touched by an individual with a contagious disease relative to an individual with a non-contagious disease or who is healthy (Gretz & Huff, 2019). This pattern has been suggested to occur due to the activation of the Behavioral Immune System (BIS)—an avoidance-based system designed to thwart sources of potential pathogens. The BIS has been suggested to operate through an evolutionary-based mechanism in which avoidance of pathogens increases the likelihood of survival, increasing reproductive success. Given this approach, an important question is how the activation of the BIS operates in older adults (60 + years of age), since older adults are past their reproductive prime, with many no longer having the physical capacity for reproduction. To evaluate the evolutionary BIS account, older adults watched a series of videos depicting an actor walking through a household scene and interacting with several objects. Prior to watching the videos, older adults were informed that the actor was either diagnosed with Influenza, a highly contagious disease, Cancer, a non-contagious disease, or was Healthy and not afflicted with any ailments. Following the videos, participants then completed a free-recall test where they were to retrieve the objects from the videos regardless if they were touched and a source-recognition test where they had to identify if a specific object was touched, not touched, or not in the videos at all. Recall of touched objects was greatest in the Influenza group, followed by the Cancer and Healthy groups, and source recognition for touched objects was only greater in the Influenza group relative to the Cancer and Healthy groups. Since touched-object recall was greater in the disease groups over the Healthy group, we instead argue for a *health-preservation account* over an evolutionary account of the BIS, in which BIS activation operates to promote longevity rather than promoting reproductive success.

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Table of Contents

List of Tables

List of Illustrations

List of Abbreviations

ANOVA	Analyses of Variance
BIS	Behavioral Immune System
d	Cohens d
F	F-Statistic
hr	Hour
IL-6	Interleukin 6
M	Mean
min	Minute
MMSE	Mini-Mental State Exam
MSE	Mean Squared Error
η_p^2	Partial-eta squared
p	P-value
PVD	Perceived Vulnerability to Disease
SD	Standard Deviation
SEM	Standard Error of the Mean
t	t-statistic

The Effects of Disease Contamination on Memory for Touched Objects in Older Adults

Exposure to bacteria and pathogens is common in everyday life. Typically, exposure to pathogens is not life threatening due to the presence of the biological immune system, which can remove pathogenic threats that have entered internally. Although the deleterious effects of pathogens are often thwarted, the biological immune system does not operate cost-free. For instance, the elevated body temperature associated with a fever can make the body inhospitable for pathogens, and increased mucus production can facilitate the removal of pathogens from the respiratory system (Nicholson, 2016; Fahy & Dickey, 2010). Deployment of the biological immune system is generally aversive for ill individuals and requires considerable energy leading to feelings of fatigue. Thus, a logical process would be to curtail the initial transmission of pathogens by detecting and avoiding sources that are associated with illness.

To avoid deployment of the biological immune system, researchers have suggested that humans have evolved a behavioral immune system (BIS), which allows for the detection and avoidance of pathogens that aids in avoiding pathogen exposure (Murray & Schaller, 2016; Neuberg, Kenrick, & Schaller, 2011; Schaller, 2006). Although there has been considerable work showing that the BIS is easily activated and that it can assist individuals in detection and avoidance of pathogens (Schaller & Park, 2011), less is known about the developmental trajectory of the BIS, particularly in old age. The purpose of my honors thesis is to evaluate the BIS in older adults to determine whether older adults show sensitivities to pathogenic sources that are typically found in younger adults.

Pathogen avoidance likely increases the probability that individuals can survive and thrive as a healthy adult. Several studies have been conducted explaining the relevance of avoidance behaviors towards infectious disease-related sources. Mortensen, Becker, Ackerman,

Neuberg, and Kendrick (2010), investigated whether priming and exposing participants to disease sources would elicit avoidant or approach movements via arm extensions. The researchers reported that reaction times for extension and flexion movements—measures of avoidance—were faster in individuals who reported greater vulnerabilities towards diseases. Thus, the more a person feels they are susceptible to an infectious illness, the more likely it is that their BIS will activate to repel contagious sources.

Similar evidence has shown that individuals are responsive to disease connoting cues that allude to the presence of pathogens (e.g., coughing, sneezing). These responses have been shown in both the BIS and the biological immune system. For instance, Schaller, Miller, Gervais, Yager, & Chen (2011), exposed participants to two forms of slideshows which displayed images of either infectious diseases or guns. presence of pathogens versus a negatively arousing stimulus would enhance the production of the pro-inflammatory cytokine, Interleukin 6 (IL-6), which is present in white blood cells. IL-6 is produced in response to infections, inflammation, and immune reactions (Tanaka, Narazaki, & Kishimoto, 2014). Participant blood tests revealed that participants produced 23.6% more IL-6 after being exposed to the infectious-disease slideshow versus the gun slideshow. Thus, perceptions of pathogens increase biological immune system function, and this pattern can occur even in the absence of direct person-to-person contact.

In addition to biological responses, contamination scenarios can also elicit memory enhancement, through the activation of the BIS. For instance, Bonin, Theiebaut, Witt, & Méot (2019), provided evidence regarding contamination effects on memory. The researchers implemented five different experiments, each with some type of contamination scenario. In one study, participants were presented with objects along with a drawing of a face of either a sick or a healthy person. Afterward, participants were given a surprise recall test where they were asked

to recall as many objects as they could. The researchers found that participants recalled more objects that were associated with sickly faces than healthy faces. Similar patterns were found in subsequent experiments that examined infection, unwashed hands, faces, and survival scenarios. Across experiments, memory was generally greater when items were associated with a contaminated source relative to when they were associated with a healthy source, providing further evidence of the BIS and the subsequent effects on memory processes.

Similar patterns have been shown by Fernandes, Pandeirada, Soares, & Nairne (2017), who also investigated the memory processes associated with the BIS using both verbal descriptions and visual cues of individuals paired with objects. Participants were shown photographs of objects and either given a short description of the person who interacted with the object or shown the face of the person. Critically, the descriptions either contained information that the person who interacted with the object was ill ("had a runny nose"), or did not provide health-related information ("had green eyes"), or the facial images either contained visual blemishes suggesting disease (e.g., rash, pimples, etc.) or did not. They were then asked to complete an immediate memory test that involved labeling objects as either being touched by a sick person or a healthy person. After completing the initial object study/test phase, participants then completed a final recall test in which they were asked to recall as many of the objects as they remember. Final test performance indicated that recall was greater for those objects that were paired with the infectious source relative to objects paired with the non-infectious source, which indicated that memory processes are sensitive to BIS activation through infectious sources.

Although a majority of the work thus far has examined how BIS activation may facilitate later memory, there is also evidence suggesting that memory systems may have adapted to be

particularly sensitive to certain types of information that can benefit longevity. In particular, accumulating evidence supports the benefits of *survival processing* on memory, which involves participants processing study information based on its relevance to survival (Narine, Thompson, & Panderirada, 2007). In survival processing experiments, participants are presented with a set of study lists and asked to study these lists using either a survival-processing task, a moving task, or a pleasantness-rating task. The survival-processing task initially provides participants with a survival scenario in which they are to imagine that they are stranded in the grasslands of a foreign land and will need to sustain their survival over a period of several months. Following this scenario, participants are then provided with a set of word lists and are required to rate these words based on their relevance for survival. In the moving control group, participants are similarly provided with a scenario but instead are told that they are moving to a new city and are asked to rate words based on their relevance for moving to a new location. In the pleasantness-rating task, participants are simply provided with a list of words and are asked to rate how pleasant or enjoyable each word is. At test, survival processing produces a memory advantage over both the moving-control and pleasantness-rating tasks. The survival benefit over these control tasks is noteworthy because it suggests that the memory system is "tuned" towards processing information relevant to survival, and importantly, this memory advantage occurs relative to a control task that also involves a relocation component. Subsequent experiments have shown that survival processing is a powerful and highly reliable effect. Indeed, it holds relative to many other non-survival control tasks that are generally classified as powerful "deep" processing tasks (e.g., Kostic, McFarlan, & Cleary, 2012).

Adaptive Memory Processes in Older Adults

Although the memory-enhancing benefits of the BIS and survival processing have been well supported, most studies have relied upon younger adult samples, and less is known about how these survival-related effects operate in an older adult population. Adults who are over the age of 65 generally have a greater risk of infection, are more susceptible to chronic illnesses and are more likely to suffer severe consequences when afflicted with an acute illness relative to younger adults. These patterns are a result of a decline in immune system functioning termed "immune exhaustion," which causes a decrease in the abilities of the biological immune system (Derhovanessian, Solana, Larbi, & Pawelec, 2008). Such a decline can be detrimental to the overall health of an older individual. For instance, a compromised immune system can lead to a decrease in the ability to ward off infectious bacteria, a poor response to vaccinations, and an increase in frailty, all of which can lead to an increase in mortality (Pawelec, 2017). Therefore, having the ability to process information in terms of survival relevance could help combat immune system declines by allowing older adults to avoid pathogenic sources.

Several researchers have examined the effects of the survival processing advantage regarding the older adult population. However, the results of their research are somewhat mixed. Pandeirada, Pinho, and Faria (2014) investigated whether healthy older adults and cognitively impaired older adults benefitted similarly from survival processing, as previously found with younger adults. Using the Nairne et al.'s (2007) survival-processing task, the authors reported that despite healthy older adults showing greater memory than cognitively impaired individuals, both groups showed the survival processing benefit relative to a moving control task. In contrast, Stillman, Coane, Profaci, Howard, and Howard (2014) did not find that older adults benefited from the survival processing study task. Again, using the standard survival processing task, the authors examined cross-sectional differences in survival processing between younger and older

adults. Younger adult participants were further split into a full- or divided-attention group, with the latter group used to provide a more appropriate comparison to older adults by mimicking their expected attentional deficits. In three separate experiments, the authors found that both of the younger adult groups showed a standard survival processing benefit relative to a moving control, but the older adult groups showed no survival processing advantage, and this null pattern was found in both between-and within-subject designs. The authors rationalized the null survival processing effect in older adults as being due to different life priorities. Prioritizing survival was not as critical for older adults as increased survival has less of an impact given fewer possible years of life remaining.

The mixed findings concerning the survival processing advantage above are interesting in regard to the evolutionary account that is often used to account for behaviors consistent with the biological and behavioral immune systems. Both systems are based on the tenant that the reproductive success and factors that may increase the probability of reproductive success are contributing to the memory improvements. When considering this account, however, older adults are an interesting case. This is because most older adults are past their reproductive prime in which the successful conception of a viable child would not be likely. Indeed, for many older adults, particularly women, they are no longer physically capable of conceiving due to biological factors associated with hormonal changes such as menopause. It is reasonable to assume that beneficial immune systems that are contingent upon reproductive capacities would no longer be active for older adults, and therefore, they would not show enhanced cognitive processes associated with the deployment of these systems. Thus, it is perhaps unsurprising that research using the survival-processing mnemonic has produced mixed findings for older adults (e.g., Pandierada et al., 2014; Stillman et al., 2014).

Given the mixed evidence for survival processing benefits in older adults, the purpose of my honors thesis is to further examine evolutionary-based processes by examining whether the BIS, which appears to produce cognitive benefits in younger adults, will also operate similarly in older adults. In particular, my study will follow up on a recent study by Gretz and Huff (2019), which gauged whether younger adults showed heightened memory for touched objects that were contaminated by individuals with a contagious disease. Specifically, participants watched a series of videos that depicted a female actor who walked through several household scenes and touched a subset of objects. Critically, prior to studying the videos, participants were informed that the actor in the video was infected with influenza, a highly contagious disease, cancer, a non-contagious disease, or was healthy and not afflicted with ailments. On later recall and source recognition tests, all participants remembered touched items at a greater rate than non-touched objects, but participants in the influenza group were particularly more likely to remember touched objects on the source test, which required participants to specify whether test objects were touched or not touched. The authors interpreted this pattern as being consistent with a BIS account versus a more general distinctiveness account because cancer, which is a distinctive disease but not contagious, did not produce a source memory improvement for touched objects, nor did it produce an increase in memory for touched objects over the healthy disease group.

For my honors project, the same experimental procedures used by Gretz and Huff (2019) were again used with the same three disease groups but using an older adult sample. By using an older adult sample, I was able to further examine the evolutionary-based account that is often used to describe the BIS. Specifically, the evolutionary account of the BIS posits that activation of the system, which improves cognitive processes, will only operate if doing so will improve survival outcomes, which will increase the likelihood of reproduction. Since older adults are

likely past their reproductive prime and even their reproductive capacity, memory for touched objects should not be enhanced when contaminated by an actor with a contagious influenza illness relative to objects touched by an individual with cancer or who is healthy. If, however, older adults do show memory facilitation for objects infected with influenza, this may indicate the presence of a more general health-preservation mechanism, rather than one that is mediated through evolutionary-based processes.

In addition to measuring disease-related effects on memory for touched objects, an individual differences measure was used to gauge individual sensitivities to disease concerns using the Perceived Vulnerability to Disease (PVD) scale (Duncan, Schaller, & Park, 2009). The 15-item PVD includes two subscales: germ aversion and perceived infect ability, to assess perceptions vulnerability to pathogens. The 8-item germ aversion subscale measures the level of discomfort individuals experience when presented with situations where there is a high probability of disease transmission. The 7-item perceived infect ability subscale measures the extent to which a participant feels they are susceptible to an infectious disease. Given the BIS and how it responds to potential sources of disease, it was expected that PVD ratings would be positively associated with memory for objects, particularly for touched objects, given those objects would serve as a direct vector for disease transmission. Indeed, Gretz and Huff (2019) showed a positive relationship between germ aversion and source memory for touched objects providing support for this pattern. Given that many older adults tend to have a compromised immune system relative to younger adults, a positive relationship between germ aversion and source memory for touched objects was again expected, though this relationship may be weakened.

Method

Participants

Eighty-four English-proficient older adults with normal or corrected-to-normal vision were recruited from various communities and organizations in the greater Southern Mississippi region. Testing was conducted at various community locations, but all were tested using the same computer equipment in a quiet environment. Participants were provided transportation to and from the testing site and were compensated at a rate of $10 for their participation. Participants were randomly assigned to either the Influenza group (n = 29), Cancer group (n = 28), or Healthy groups (n = 28). Data from one participant in the Influenza group was eliminated due to a Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975) score below 24, suggesting the presence of cognitive impairment, leaving 28 Influenza participants available for analysis.

Mean age, education level, Mini-Mental Status, and Shipley vocabulary (Shipley, 1940) are reported in Table 1. We further conducted a sensitivity analysis using G*Power (Erdfelder, Faul, & Bucher, 1996), which indicated that the sample size in the present study has sufficient power (.80) to detect medium-to-large effect sizes (e.g., Cohen's d = .70) or greater when comparing across disease groups.

Materials

Four silent digital videos used by Gretz and Huff (2019) served as study materials. In each video, a single female actor was depicted walking through four household contexts (bedroom, bathroom, kitchen, and garage; see Appendix A for still image examples), randomly touching a subset of objects. Videos were based on static household images used by Huff, Weinsheimer, and Bodner (2016) and were always presented in the same order as listed above.

Videos contained an average of 25.25 objects (range = 22-27) and were normed to be schematically consistent with each household context. In each video, ten items were touched by the actor, which were randomly selected from the normed data and distributed evenly across the scenes to minimize potential serial-position effects. Two versions of videos were created: One for the Influenza group and the other for the Cancer and Healthy groups. The only difference in each version occurred at the beginning of the video in which the Influenza actor sneezed before touching objects to reinforce the presence of a contagious illness, whereas the healthy and cancer actor did not. In order to enhance external validity, each version was filmed using two different female actors, yielding four total sets of videos (two video sets for the influenza version, each with a different actress, and two video sets for the healthy/cancer versions, each with a different actress). Participants only viewed one video set depending on their randomly assigned disease group, and video sets were counterbalanced across participants to ensure that the different actresses in the videos were used equivalently in each disease group. The items in the videos and the order in which the items were touched were identical across versions. The mean video duration was 46.38 s (*SD* = 5.26 s), which was equivalent across videos, *t*s < 1.

The 15- item PVD scale (Duncan et al., 2009) was also administered and contained questions from two subscales: Germ aversion and perceived infectability. The germ aversion subscale consisted of eight items to assess an individual's emotional aversion to pathogens (e.g., "It really bothers me when people sneeze without covering their mouths"). The perceived infectability subscale consisted of seven items to disease susceptibility (e.g., " I have a history of susceptibility to infectious diseases"). A 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) was used to assess perceptions of disease vulnerability. Six items were reversed scored. The overall PVD (*M* = 3.70; range = 2.42-5.62; α = .75), the germ aversion

subscale (*M* = 4.31; range = 3.56-3.63; α = .64), and the perceived infectability subscale (*M* = 3.01; range = 2.42-3.63; α = .80) had acceptable reliabilities. Participants also completed the MMSE, a standard screen for cognition impairment, which consists of brief assessments in attention, memory, orientation, and visual-spatial abilities. We utilized a cut-off score of 24 or greater to classify participants as possessing normal cognitive functions. The mean MMSE score was 28.70 (*SD* = 1.29; range = 30-24). Finally, participants were asked to complete the Shipley Vocabulary Scale (Shipley, 1940). This multiple-choice vocabulary test determined how well the participants could match a test word with its correct synonym. The mean Shipley score was 31.98 (*SD* = 5.33; range = 18-40).

Procedure

Most participants were tested individually, though a few were tested in groups of two. Testing individuals versus pairs were distributed evenly across the three disease groups. Following informed consent, participants were instructed that they would view a series of four videos, each showing an individual walking through a household context and interacting with a variety of objects. Participants were further instructed to try to remember all objects in each video regardless if the individual interacted with the object or not. Videos were displayed on a computer monitor for individual participants. Prior to each video, participants were provided disease-related information about the actor both visually and auditorily. The disease information provided was identical to the information provided in Gretz and Huff (2019). Specifically, the Influenza group was informed that the individual in the scene "was recently diagnosed with influenza, a highly contagious disease that can result in fever, sore throat, and muscle or body aches." The Cancer group was informed that the individual in the scene was "recently diagnosed with cancer, a noncontagious disease that can result in anemia, the development of bodily lumps,

and changes in digestive movements. The Healthy group was informed that the individual in the scene "was healthy and not afflicted with any ailments." Participants studied all four scenes in the order listed above with specific disease/healthy instructions repeated before each video.

Following the presentation of all four videos, participants completed a 2-min arithmetic filler task followed by a scene-cued recall test. Participants were given a recall sheet and asked to write down as many objects as they could remember from a particular scene for 2 min, regardless of whether the objects were interacted with or not. Each scene was tested individually and in the same order as the study with no delay in between tests. Immediately after completing the recall task, participants then completed a forced choice, 34-item source-recognition test. The test consisted of 24 presented items (three touched and three non-touched items randomly selected from each scene) and ten nonpresented household items that were listed as uncommon in the scenes in Gretz and Huff's (2019) norming study. The items in the source test were randomized and presented in the same order to all participants. Participants classified their memory for each item as touched (meaning the actor touched the item), non-touched (meaning that the actor did not touch the item), or neither (meaning the item was not presented in the scenes at all). Both the recall and source-recognition tests were identical to those used by Gretz and Huff. Immediately following the source test, participants then completed a series of questionnaires which included, the MMSE, Shipley Vocabulary Scale, PVD, and a demographics questionnaire, completed in this order (see Appendix B for all questionnaires used in the study). The experimental session lasted approximately 1 hr.

Results

Significant comparisons are accompanied by effect size estimates using partial-eta squared (η_p^2) for Analyses of Variance (ANOVAs) and Cohen's *d* for *t*-tests. Table 2 reports mean proportions of correctly recalled items as a function of disease group for touched and non-touched items and proportions of source attributions reported for touched, non-touched, and non-presented items.

Free Recall

Correct recall was calculated by taking the total number of non-repeated objects recalled (i.e., those only recalled once), divided by the total number of objects presented in each scene. Proportions of recalled objects were then analyzed using a 3 (Disease Group: healthy vs. cancer vs. influenza) × 2 (Object Type: touched vs. non-touched) mixed ANOVA. A significant main effect of object type was found, $F(1, 81) = 304.95$, $MSE = .014$, $\eta_p^2 = .79$, $p < .001$, in which correct recall was greater for touched than non-touched objects (.46 vs. .22). A main effect of disease group was also found, $F(2, 81) = 6.80$, $MSE = .19$, $p < .01$, $\eta_p^2 = .14$, which indicated greater correct recall for both the Influenza and Cancer groups relative to the Healthy group (.38 vs. .30; $t(54) = 3.60$, $SEM = .01$, $p < .01$, $d = 0.98$) and (.35 vs. .30; $t(54) = 2.10$, $SEM = .02$, $p < .01$, $d = 0.57$), respectively, but no recall difference between the Influenza and Cancer groups (.38 vs. .35), $t(54) = 1.57$, $SEM = .02$, $p = .12$.

Importantly, these main effects were qualified by a significant interaction, $F(2, 81) = 6.04$, $MSE = .01$, $p < .01$, $\eta_p^2 = .13$, which indicated that disease-related recall differences only occurred for objects that were touched in the videos. Specifically, for touched objects, recall was greater in both the Influenza and the Cancer groups relative to the healthy group (.52 vs. .39; $t(54) = 4.40$, $SEM = .03$, $p < .001$, $d = 1.20$) and (.48 vs. .39; $t(54) = 2.99$, $SEM = .03$, $p <$

.01, d = 0.81), respectively, with no difference between the Influenza and Cancer groups (.52 vs. .48), $t(54) = 1.57$, SEM = .03, p = .15. For non-touched items however, there were not differences between the Healthy (M = .21), Influenza (M = .24), or Cancer (M = .21) groups, all ts < 1.05, ps > .30. Thus, knowledge that the actor in the video had a disease facilitated recall, but only for objects touched by the actor and there were no differences between the contagious Influenza and the non-contagious Cancer groups. Finally, the mean number of extra-video intrusions was also compared. Intrusions were relatively rare and did not differ across disease groups, $F < 1$.

Source Recognition

Source recognition responses were computed as the proportion with which participants reported recognition items as either being touched, not touched, or not presented in the initial videos. For touched items, correct source recognition was computed as the proportion of touched items that were correctly attributed as touched in the videos. A one-way ANOVA found a significant difference across groups, $F(2, 81) = 7.45$, MSE = .06, $p < .01$, $\eta_p^2 = .16$, which indicated that correct touched-item attributions were greater in the Influenza group relative to both the Healthy group (.68 vs. .44), $t(54) = 3.78$, SEM = .06, $p < .001$, d = 0.70, and the Cancer group (.68 vs. .54), $t(54) = 2.44$, SEM = .04, p = .02, d = 0.65. Unlike the free recall, however, there was no difference in correct source attributions of touched items between the Healthy and Cancer groups (.44 vs. .54), $t(54) = 1.48$, SEM = .07, p = .14. Correct source attributions were also analyzed for non-touched items (non-touched items attributed as “not touched”) and correct attributions for non-presented items (non-presented items attributed as “neither”). For both attribution types, however, no differences were found across groups, both Fs < 2.56, ps > .08.

Therefore, correct source attributions were enhanced in the Influenza group, but only for touched items that were physically contaminated by the infectious actor.

PVD Correlations

Correlations between the overall PVD scale, the two subscales (infectability and germ aversion), and recall and source attributions for touched and non-touched items are reported in Table 3. In contrast to predictions, a *negative* relationship was found between the overall PVD scale and the recall of touched items $r(84) = -.23$, $p = .04$, and between the germ aversion subscale recall of touched items $r(84) = -.25$, $p = .02$. To test whether these negative relationships depended upon disease group, an analysis of covariance was run to test for the PVD and germ aversion by disease group interaction. Both analyses yielded significant interactions, $F(3, 80) = 10.34$, $MSE = .01$, $p < .001$, $\eta_p^2 = .28$, and $F(3, 80) = 9.23$, $MSE = .01$, $p < .001$, $\eta_p^2 = .26$, for the analyses with the overall PVD and germ aversion subscale, respectively. Therefore, correlations between PVD, germ aversion, and touched item recall were conducted separately for the three disease groups. Specifically, significant negative correlations were found between PVD and touched item recall in the Cancer group, $r(28) = -.44$, $p = .02$, and between germ aversion and touched item recall in the Cancer group, $r(28) = -.37$, $p = .05$, and in the Healthy group, $r(28) = -.38$, $p = .05$. All other correlations, including those with the Influenza group, were not significant, rs < .28, ps > .13. Note that these patterns are in the *opposite* direction of those expected based on BIS activation and the positive relationship that Gretz and Huff (2019) reported between germ aversion and touched source recognition. Here, greater concerns regarding perceptions of disease vulnerability and germ aversion were associated with lower rates of recall of touched objects. These peculiar patterns are discussed further in the General Discussion but indicate here that the PVD scale was completed after

participants had completed the study and could be affected by carryover effects of the disease group, which could have affected PVD responses for the Cancer and Healthy groups differently.

No other correlations between the PVD and the other memory measures were reliable, *r*s < .19, *p*s > .08.

General Discussion

The results obtained in this study provide evidence for the activation of the BIS within an older adult sample. Older adult participants overall had a greater recall for objects touched by an actor over non-touched objects and touched object recall interacted with the presence of a disease. Specifically, recall of touched objects was greater when the actor was described as having either influenza or cancer relative to when the actor was healthy. Importantly, this pattern was not found in the recall of non-touched objects, indicating that participants prioritized the encoding of objects that may have been contaminated by an individual with a disease rather than objects that were not touched and therefore were not physically contaminated. On a subsequent source recognition test, which required participants to specify whether objects were touched or not, participants were again better able to correctly attribute the source of touched objects as touched, and particularly so in the influenza group relative to the cancer and healthy groups, which did not differ. This pattern replicated that of Gretz and Huff (2019), who used a younger adult sample. Thus, not only did the presence of a disease facilitate the recall of touched objects, but the presence of influenza also increased the likelihood that participants would recollect the contextual source of which objects were touched. Again, this disease-related effect did not emerge for non-touched items or correct rejections of objects that were not presented anywhere in the scenes, providing further evidence that only those objects that were contaminated through physical contact were sensitive to disease-related effects.

The inclusion of older adults was to test the evolutionary account of the BIS in that the avoidance of pathogenic sources was for increasing reproductive success. It was argued that if the BIS operates to benefit reproduction, older adults would not show sensitivity towards contagious diseased sources given their reduced capacities for reproduction. In contrast, older adults showed a robust sensitivity towards objects that were touched by a diseased actor, suggesting that an evolutionary-based process may not be an adequate account of the BIS effects on memory. The presence of influenza, a highly contagious illness, appeared to produce the strongest effect. However, touched objects were remembered at a similar rate in both the influenza and cancer groups, the source recognition data indicated that only the influenza actor produced an increase in the source recognition of touched objects. This pattern suggests that the presence of a contaminated disease may be more likely to increase attention, which, in turn, leads to greater recollection for touched objects.

Given the disease facilitation effect found in older adults, particularly for the influenza group, it is possible that older adults, and possibly younger adults, show BIS activation as a means to preserve their own personal health for longevity purposes rather than reproduction. This *health-preservation account* is more consistent with the reported older adult data and also adequately accounts for disease sensitivity effects on memory reported in other studies using younger adult samples (e.g., Bonin et al., 2019; Fernandes et al., 2017; Gretz & Huff, 2019).

Although the recall and source recognition analyses were consistent with a BIS process, the correlations obtained from the PVD scale and its two subscales (infect ability and germ aversion) were not. Specifically, it was expected that there would be a positive relationship between the PVD and recall and source recognition for touched items. Recall of touched items was negatively correlated with the overall PVD and germ aversion subscales, and source

recognition of touched items was not correlated with any of the PVD measures. Indeed, these relationships are inconsistent with our prediction that individual differences in disease-related concerns would facilitate attention towards diseased sources, thereby benefitting memory. These results are also inconsistent with Gretz and Huff (2019), who reported a small positive correlation between germ aversion and correct source memory for touched items. An obvious reason for this difference may be that older adults are fundamentally different regarding their disease concerns (cf. Stillman et al., 2014). Speculatively, younger adults have more years of life left and may be more motivated to preserve this additional time through the avoidance of costly diseases. As a result, younger adults may show greater disease-related concerns overall, which may be more sensitive to germs and infections.

Additionally, it is possible that the PVD responses could have been influenced by the disease instructions for each group since the PVD was completed at the end of the study after participants had already been exposed to the different disease instructions. Indeed, analyses of the PVD data showed disease group differences, suggesting that the different disease groups may have affected the PVD differently, given that participants were randomly assigned to the different disease groups. Of course, having participants complete the PVD prior to the study would have eliminated these potential carryover effects. The PVD comparison was a secondary goal of the present study; however, an interesting avenue for future research would be to examine how PVD responses change as a result of recent exposure to disease-related information.

Limitations and Directions for Future Research

There are a few limitations associated with this study. First, it is unclear to determine precisely how the BIS is activated in the context of the different disease groups. Specifically, it is

possible that simply mentioning the health status of an individual is enough to activate the BIS. Therefore, even in the Healthy group, the BIS may have been activated, but the BIS may have been relatively more activated in the Influenza group. In order to test this possibility, another control group in which there is no mention of health status would need to be implemented to gauge whether the BIS is even partially activated in the Healthy group.

Another limitation is that there has not been a consensus on how "adaptive cognition" operates in older adults, as shown by the inconsistency of older adults in survival processing. It has been suggested that older adults should not engage in any type of survival processing, BIS activation included, because of their lack of or decrease in reproductive capabilities, which from an evolutionary perspective is the premise for survival (Stillman et al., 2014). Therefore, more research is still needed to determine if older adults truly have a need to engage in BIS activation.

Additionally, for the influenza group, a possible limitation is that the influenza video is confounded with a sneeze. It is possible that in a real-world scenario, where there is a true risk of disease contamination, the sneeze could be more effective. In addition, the presence of the sneeze in the influenza group may also have had an effect on the results of the study. Since the sneeze is only associated with the influenza group and not the cancer nor healthy group, it could have caused an increase in memory that was due to the sneeze and not the influenza disease as a whole. The inclusion of the sneeze was to increase the salience of the disease manipulation in the influenza group; it is important to emphasize that it is unclear whether knowledge of influenza by itself is sufficient to produce an increase in touched object memory or if the sneeze needs to be coupled with influenza information. Alternatively, the sneeze may be driving this pattern, and the influenza information may be unimportant. Importantly, however, early data from an unpublished study may provide some information regarding the effects of a sneeze. In this study,

younger adult participants completed the same paradigm, with the exception that the cancer and influenza groups were compared to an Ebola disease group that did not contain a sneeze. The Ebola group showed the same increase for source memory for touched items over the cancer and healthy groups consistent with activation of the BIS. Therefore, these data suggest that it is unlikely that the sneeze is exclusively responsible for the exaggerated effect. However, the inclusion of the sneeze leads to an important question: What specific cues may lead to BIS activation that can facilitate memory for contaminated objects? Studies such as those by Bonin et al. (2019) and Fernandes et al. (2017), suggest that facial details can be a marker for disease leading to memory changes. The present study suggests that instructions are sufficient, but it is possible that there could be other cues that are more subtle that can activate the BIS. The effects of cue types on BIS activation leaves an interesting area for future research, which may reveal the specific circumstances in which the BIS can contribute to object memory.

Another area of future research for this study would be to examine how the BIS operates amidst a pandemic. Recently a highly contagious respiratory illness, COVID-19, spread throughout the world, causing individuals to become very cautious of their surroundings in terms of avoiding possible areas of contamination. Individuals engaged in many disease avoidant behaviors such as wearing gloves, masks, and avoiding contact with others. This was especially true for individuals with compromised immune systems (e.g., children, older adults, etc.). Therefore, it would be interesting to examine how the BIS responds to such adverse disease threats, compared to a common illness like influenza.

Conclusion

The results of this study provide important insights into how the BIS can affect memory performance in older adults and suggests an alternative explanation for their ability to retrieve sources of contamination. Overall, participants recalled and had better source recognition for touched over non-touched items, but touched items were remembered particularly well when touched by the influenza actor relative to the cancer and healthy actors. This pattern is consistent with the BIS account but inconsistent with the evolutionary-based mechanism associated with the BIS. These data are more consistent with a general health-preservation mechanism in which attending to disease-related objects and their context leads to enhanced memory for those objects even though older adults are past their reproductive prime. Of course, more research is needed to further evaluate potential mechanisms of the BIS, particularly whether a health-preservation account holds in younger adults who are likely more tuned to reproductive success.

Table 1

Participant Characteristics and Mean (± 95% CI) PVD Scale Responses as a Function of Healthy, Influenza, and Cancer Disease Groups.

	Healthy	Influenza	Cancer
N	28	28	28
Age (yrs.)	71.46 (± 2.95)	72.86 (± 3.00)	73.75 (± 2.90)
Education (yrs.)	13.79 (± 1.12)	16.39 (± 1.03)	14.96 (± 1.10)
PVD Scale	3.83 (± 0.37)	3.83 (± 0.34)	3.45 (± 0.33)
Infectability	3.12 (± 0.50)	3.04 (± 0.40)	2.87 (± 0.44)
Germ Aversion	4.45 (± 0.41)	4.52 (± 0.46)	3.96 (± 0.38)

Notes. PVD = Perceived Vulnerability to Disease Scale (Duncan et al., 2009). Infectability and Germ Aversion are the two subscales of the PVD.

Table 2

Mean (± 95% CI) Proportions of Correct Recall, Number of Intrusions per List Recall, and Source Attributions for Touched Non-Touched Items, or Non-Presented Items as a Function of Healthy, Influenza, and Cancer Disease Group.

Item Type/ "Attribution"	Healthy	Influenza	Cancer
Free Recall Test			
Touched Items	.39 (± .05)	.52 (± .04)	.48 (± .04)
Non-Touched Items	.21 (± .04)	.24 (± .03)	.22 (± .03)
Difference	.17 (± .04)	.28 (± .05)	.26 (± .05)
Intrusions per Video	1.49 (± .35)	1.39 (± .31)	1.38 (± .29)
Source Monitoring Test			
Touched Items			
"Touched"	.44 (± .10)	.68 (± .08)	.54 (± .09)
"Non-Touched"	.45 (± .09)	.23 (± .06)	.35 (± .08)
"Neither"	.10 (± .04)	.08 (± .03)	.12 (± .03)
Non-Touched Items			
"Touched"	.18 (± .05)	.16 (± .04)	.10 (± .04)
"Non-Touched"	.47 (± .06)	.39 (± .07)	.45 (± .07)
"Neither"	.35 (± .05)	.45 (± .06)	.45 (± .06)
Non-Presented Items			
"Touched"	.11 (± .05)	.08 (± .03)	.09 (± .04)
"Non-Touched"	.19 (± .05)	.13 (± .05)	.13 (± .05)
"Neither"	.70 (± .06)	.79 (± .07)	.79 (± .06)

Table 3

Correlations with the PVD Scales and Subscales and Correct Recall and Source Attributions for Touched Items.

Variable	1	2	3	4	5	6	7
1.) PVD Scale	—						
2.) Infectability	.78**	—					
3.) Germ Aversion	.81**	.27*	—				
4.) Touched Recall	-.23*	-.10	-.25*	—			
5.) Non-Touched Recall	-.19	-.16	-.15	.30*	—		
6.) Touched Source	-.05	-.01	-.06	.46**	-.15	—	
7.) Non-Touched Source	.04	-.01	.06	-.15	.16	-.40**	—

Notes. ** = $p < .01$, * = $p < .05$, ^ = $p < .10$, two-tailed. PVD = Perceived Vulnerability to Disease Scale (Duncan et al., 2009). Infectability and Germ Aversion are the two subscales of the PVD.

References

Bonin, P., Thiebaut, G., Witt, A., & Méot, A. (2019). Contamination Is "Good" for Your Memory! Further Evidence for the Adaptive View of Memory. *Evolutionary Psychological Science*, *5*(3), 300–316. https://doi.org/10.1007/s40806-019-00188-y

Cansino, S., Torres-Trejo, F., Estrada-Manilla, C., Ramírez-Barajas, L., Pérez-Loyda, M., Nava-Chaparro, A., Hernández-Ladrón-deGuevara, M., & Ruiz-Velasco, S. (2019). Predictors of Source Memory Success and Failure in Older Adults. *Frontiers in Aging Neuroscience*, *11*, 17. https://doi.org/10.3389/fnagi.2019.00017

Derhovanessian, E., Solana, R., Larbi, A., & Pawelec, G. (2008). Immunity, ageing and cancer. *Immunity & Ageing*, *5*(1), 11. https://doi.org/10.1186/1742-4933-5-11

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences*, *47*(6), 541–546. https://doi.org/10.1016/j.paid.2009.05.001

Erdfelder, E., Faul, F., & Buchner, A. (1996). GPOWER: A general power analysis program. *Behavior Research Methods, Instruments, & Computers*, *28*(1), 1–11. https://doi.org/10.3758/BF03203630

Fahy, J. V., & Dickey, B. F. (2010). Airway Mucus Function and Dysfunction. *The New England Journal of Medicine*, *363*(23), 2233–2247. https://doi.org/10.1056/NEJMra0910061

Fernandes, N. L., Pandeirada, J. N. S., Soares, S. C., & Nairne, J. S. (2017). Adaptive memory: The mnemonic value of contamination. *Evolution and Human Behavior*, *38*(4), 451–460. https://doi.org/10.1016/j.evolhumbehav.2017.04.003

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). “Mini-mental state”. A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*(3), 189–198. https://doi.org/10.1016/0022-3956(75)90026-6

Gretz, M. R., & Huff, M. J. (2019). Did you wash your hands? Evaluating memory for objects touched by healthy individuals and individuals with contagious and noncontagious diseases. *Applied Cognitive Psychology, 33*(6), 1271–1278. https://doi.org/10.1002/acp.3604

Huff, M. J., Weinsheimer, C. C., & Bodner, G. E. (2016). Reducing the Misinformation Effect Through Initial Testing: Take Two Tests and Recall Me in the Morning? *Applied Cognitive Psychology, 30*(1), 61–69. https://doi.org/10.1002/acp.3167

Kostic, B., McFarlan, C. C., & Cleary, A. M. (2012). Extensions of the survival advantage in memory: Examining the role of ancestral context and implied social isolation. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *38*(4), 1091–1098. https://doi.org/10.1037/a0026974

Mortensen, C. R., Becker, D. V., Ackerman, J. M., Neuberg, S. L., & Kenrick, D. T. (2010). Infection Breeds Reticence: The Effects of Disease Salience on Self-Perceptions of Personality and Behavioral Avoidance Tendencies. *Psychological Science, 21*(3), 440–447. https://doi.org/10.1177/0956797610361706

Murray, D. R., & Schaller, M. (2016). Chapter Two - The Behavioral Immune System: Implications for Social Cognition, Social Interaction, and Social Influence. In J. M. Olson & M. P. Zanna (Eds.), *Advances in Experimental Social Psychology* (Vol. 53, pp. 75–129). Academic Press. https://doi.org/10.1016/bs.aesp.2015.09.002

Nairne, J. S., Thompson, S. R., & Pandeirada, J. N. S. (2007). Adaptive memory: Survival processing enhances retention. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*(2), 263–273. https://doi.org/10.1037/0278-7393.33.2.263

Neuberg, S. L., Kenrick, D. T., & Schaller, M. (2011). Human threat management systems: Self-protection and disease avoidance. *Neuroscience & Biobehavioral Reviews*, *35*(4), 1042–1051. https://doi.org/10.1016/j.neubiorev.2010.08.011

Nicholson, L. B. (2016). The immune system. *Essays in Biochemistry*, *60*(3), 275–301. https://doi.org/10.1042/EBC20160017

Pandeirada, J. N. S., Pinho, M. S., & Faria, A. L. (2014). The mark of adaptive memory in healthy and cognitively impaired older adults and elderly. *Japanese Psychological Research*, *56*(2), 168–179. https://doi.org/10.1111/jpr.12040

Pawelec, G. (2018). Age and immunity: What is "immunosenescence"? *Experimental Gerontology*, *105*, 4–9. https://doi.org/10.1016/j.exger.2017.10.024

Prull, M. W., Crandell Dawes, L. L., Martin III, A. M., Rosenberg, H. F., & Light, L. L. (2006). Recollection and Familiarity in Recognition Memory: Adult Age Differences and Neuropsychological Test Correlates. *Psychology & Aging*, *21*(1), 107–118. https://doi.org/10.1037/0882-7974.21.1.107

Rowe, J. W., & Kahn, R. L. (1987). Human aging: Usual and successful. *Science (New York, N.Y.)*, *237*(4811), 143–149. https://doi.org/10.1126/science.3299702

Schaller, M., Miller, G. E., Gervais, W. M., Yager, S., & Chen, E. (2010). Mere visual perception of other people's disease symptoms facilitates a more aggressive immune response. *Psychological Science*, *21*(5), 649–652. https://doi.org/10.1177/0956797610368064

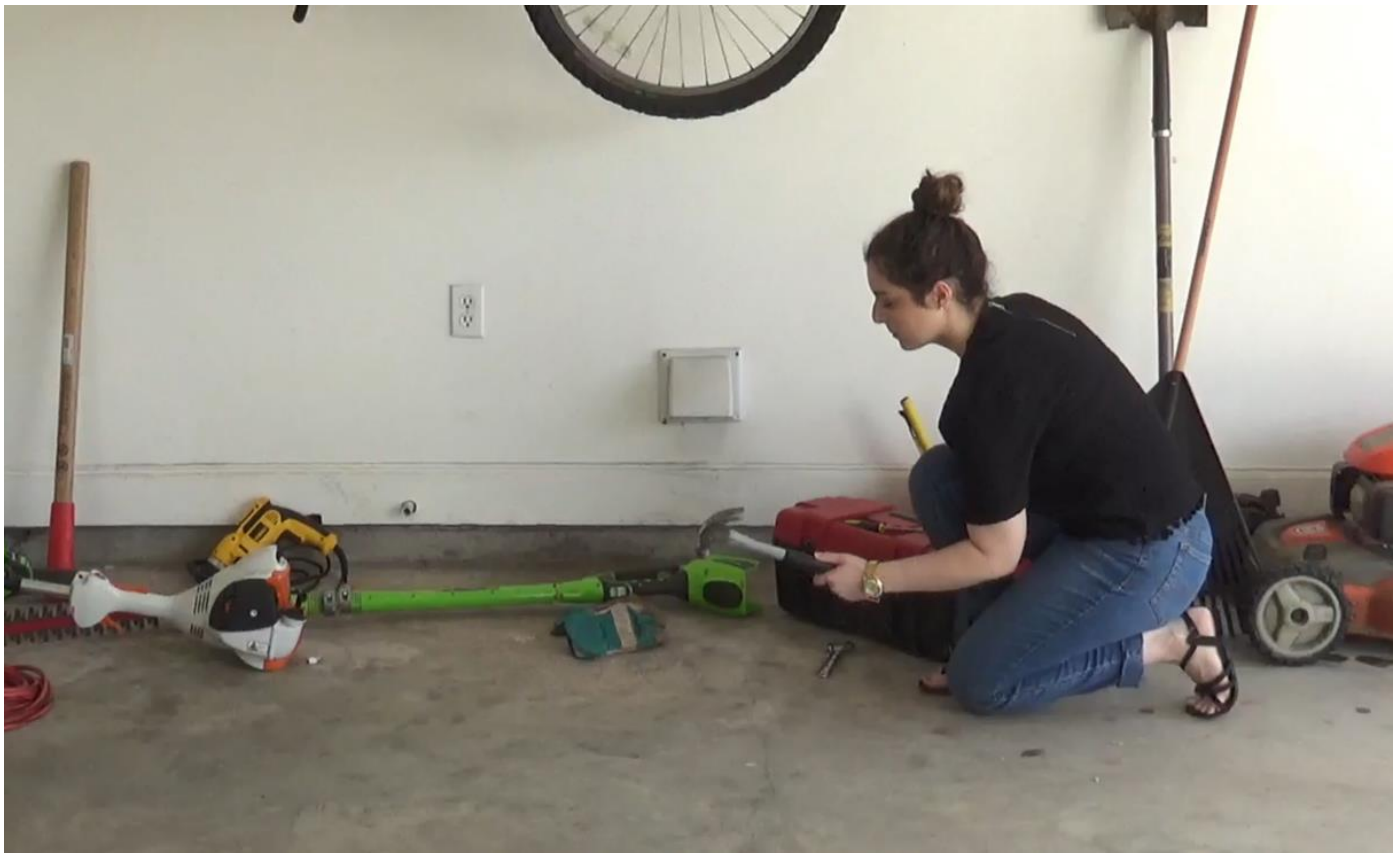
Schaller, M., & Park, J. H. (2011). The Behavioral Immune System (and Why It Matters). *Current Directions in Psychological Science, 20*(2), 99–103. https://doi.org/10.1177/0963721411402596

Shipley, W. C. (1940). A self-administering scale for measuring intellectual impairment and deterioration. *The Journal of Psychology: Interdisciplinary and Applied, 9*, 371–377. https://doi.org/10.1080/00223980.1940.9917704

Stillman, C., Coane, J., Profaci, C., Howard, J., & Howard, D. (2014). The effects of healthy aging on the mnemonic benefit of survival processing. *Memory & Cognition*, *42*(2), 175–185. https://doi.org/10.3758/s13421-013-0353-2

Tanaka, T., Narazaki, M., & Kishimoto, T. (2014). IL-6 in inflammation, immunity, and disease. *Cold Spring Harbor Perspectives in Biology, 6*(10), a016295. https://doi.org/10.1101/cshperspect.a016295

Appendix A



Appendix B

Subject ID: _____ Date: _____

Mini Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975)

Orientation

1. What is the	Year?	_____ (1)
	Date?	_____ (1)
	Day?	_____ (1)
	Season?	_____ (1)
2. Where are we?	State?	_____ (1)
	Country?	_____ (1)
	City?	_____ (1)
	Building?	_____ (1)
	Floor?	_____ (1)

Registration

3. Say "Ball, Flag, and Tree."
   Have the participant repeat them back to you. _____ (3)

Attention and Calculation

4. Serial Sevens. Count backwards by 7s from 100. _____ (5)
   100; 93; 86; 79; 72; 65. Stop at 65.

Recall

5. As for the names of the three objects that were learned in question 3. _____ (3)

Language

6. Point to a pencil and a watch. Have the participant name them as you point to each. _____ (2)
7. Repeat: "No ifs, ands, or buts" _____ (1)
8. Follow a three-stage command. _____ (3)
   "Take a piece of paper in your hand. Fold it in half.
   Place on the floor under your chair."
9. Have the participant read and obey the following command: _____ (1)
   "Close your eyes" on the separate page.
10. Have the participant write a sentence of their own choice. _____ (1)
    Sentence should contain a subject and an object, and it should make sense. Ignore spelling errors while scoring.
11. Have the participant copy the design on the sheet of paper. _____ (1)
    Give one point if all sides and angles are preserved.

Total: _____ (30)

Subject ID: _____ Date: _____

Close Your Eyes

Subject ID: _____ Date: _____

Subject ID: _____ Date: _____

Shipley Vocabulary Scale

Directions: Circle the word on the right that is synonymous with the bolded word on the left.

1.	**Talk**	Draw	Eat	Speak	Sleep
2.	**Permit**	Allow	Sew	Cut	Drive
3.	**Pardon**	Forgive	Pound	Divide	Tell
4.	**Couch**	Pin	Eraser	Sofa	Glass
5.	**Remember**	Swim	Recall	Number	Defy
6.	**Tumble**	Drink	Dress	Fall	Think
7.	**Hideous**	Silvery	Tilted	Young	Dreadful
8.	**Cordial**	Swift	Muddy	Leafy	Hearty
9.	**Evident**	Green	Obvious	Skeptical	Afraid
10.	**Impostor**	Conductor	Officer	Book	Pretender
11.	**Merit**	Deserve	Distrust	Fight	Separate
12.	**Fascinate**	Welcome	Fix	Stir	Enchant
13.	**Indicate**	Defy	Excite	Signify	Bicker
14.	**Ignorant**	Red	Sharp	Uninformed	Precise
15.	**Fortify**	Submerge	Strengthen	Vent	Deaden
16.	**Renown**	Length	Head	Fame	Loyalty
17.	**Narrate**	Yield	Buy	Associate	Tell
18.	**Massive**	Bright	Large	Speedy	Low
19.	**Hilarity**	Laughter	Speed	Grace	Malice
20.	**Smirched**	Stolen	Pointed	Remade	Soiled
21.	**Squander**	Tease	Belittle	Cut	Waste

BACK→

Subject ID: _____ Date: _____

22.	**Caption**	Drum	Ballast	Heading	Ape
23.	**Facilitate**	Help	Turn	Strip	Bewilder
24.	**Jocose**	Humorous	Paltry	Fervid	Plain
25.	**Apprise**	Reduce	Strew	Inform	Delight
26.	**Rue**	Eat	Lament	Dominate	Cure
27.	**Denizen**	Senator	Inhabitant	Fish	Atom
28.	**Divest**	Dispossess	Intrude	Rally	Pledge
29.	**Amulet**	Charm	Orphan	Dingo	Pond
30.	**Inexorable**	Untidy	Involatile	Rigid	Sparse
31.	**Serrated**	Dried	Notched	Armed	Blunt
32.	**Lissome**	Moldy	Loose	Supple	Convex
33.	**Mollify**	Mitigate	Direct	Pertain	Abuse
34.	**Plagiarize**	Appropriate	Intend	Revoke	Maintain
35.	**Orifice**	Brush	Hole	Building	Lute
36.	**Querulous**	Maniacal	Curious	Devout	Complaining
37.	**Pariah**	Outcast	Priest	Lentil	Locker
38.	**Abet**	Waken	Ensue	Incite	Placate
39.	**Temerity**	Rashness	Timidity	Desire	Kindness
40.	**Pristine**	Vain	Sound	First	Level

Total Correct _____

My Immune System

Please respond to the questions using the following scale.

Strongly Disagree						**Strongly Agree**
1	2	3	4	5	6	7

_____ 1. It really bothers me when people sneeze without covering their mouths.

_____ 2. If an illness is 'going around,' I will get it.

_____ 3. I am comfortable sharing a water bottle with a friend.

_____ 4. I don't like to write with a pencil someone else has obviously chewed on.

_____ 5. My past experiences make me believe I am not likely to get sick even when my friends are sick.

_____ 6. I have a history of susceptibility to infectious diseases.

_____ 7. I prefer to wash my hands pretty soon after shaking someone's hand.

_____ 8. In general, I am very susceptible to colds, flu, and other infectious diseases.

_____ 9. I dislike wearing used clothes because you don't know what the past person who wore it was like.

_____ 10. I am more likely than the people around me to catch an infectious disease.

_____ 11. My hands do not feel dirty after touching money.

_____ 12. I am unlikely to catch a cold, flu, or other illness, even if it is going around.

_____ 13. It does not make me anxious to be around sick people.

_____ 14. My immune system protects me from most illnesses that other people get.

_____ 15. I avoid using public telephones because of the risk that I may catch something from the previous user.

Subject ID: _____ Date: _____

Demographics Questionnaire

We would like to collect some information from you in an effort to help us characterize the sample of participants who sign up for our research studies. Note that the questions about ethnicity are not tied to our experimental hypotheses or results nor will they be reported on an individual subject basis. Instead, reports regarding ethnicity will be based on cumulative responses calculated across all participants.

1. Please report your age (in years):_____
2. Please report your gender:_____
3. Please indicate the number of years of schooling that you have completed. _____
   (12 = finished high school, add or subtract years for more/less education)
4. Please report your field of study/school major or occupation: _____
5. Please indicate what time of day you feel most alert:

_____Morning

_____Afternoon

_____Evening

_____No differences

6. Please place a check beside **one or more** of the following racial categories that apply to you:

_____ American Indian / Alaskan Native

_____Asian

_____Native Hawaiian or Other Pacific Islander

_____Black / African American

_____White / Caucasian

_____Prefer Not to Respond

7. Do you consider yourself to be Hispanic or Latino?

____Yes

____No

____Prefer Not to Respond

Subject ID: _____ Date: _____

8. Is English your first language?

   ___Yes

   ___No → Please indicate your first language_____

9. Is there anything we should know about that might affect your performance during the testing session today (e.g. lack of sleep, feeling ill, etc.)?

Appendix C

Office *of*
Research Integrity

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NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

The project below has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services regulations (45 CFR Part 46), and University Policy to ensure:

- The risks to subjects are minimized and reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered involving risks to subjects must be reported immediately. Problems should be reported to ORI via the Incident template on Cayuse IRB.
- The period of approval is twelve months. An application for renewal must be submitted for projects exceeding twelve months.
- FACE-TO-FACE DATA COLLECTION WILL NOT COMMENCE UNTIL USM'S IRB MODIFIES THE DIRECTIVE TO HALT NON-ESSENTIAL (NO DIRECT BENEFIT TO PARTICIPANTS) RESEARCH.

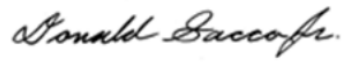
PROTOCOL NUMBER: IRB-20-219
PROJECT TITLE: The Effects of Disease Contamination on Memory for Objects and Words
SCHOOL/PROGRAM: School of Psychology, Psychology
RESEARCHER(S): Mark Huff, Nicholas Maxwell, Kendal Smith, Jessica Runnels

IRB COMMITTEE ACTION: Approved
CATEGORY: Expedited

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral

history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

PERIOD OF APPROVAL: April 29, 2020



Donald Sacco, Ph.D.
Institutional Review Board Chairperson

Honors Scholar and Thesis Advisor IRB and IACUC Statement

I, Jessica Runnels (Student Name) w986286 (Student ID)

have read the IACUC and IRB resource sheets and consulted my advisor

Dr. Mark Huff (Advisor Name)

about the need for approval from one of these committees.

We have determined that my planned study:

Does not ☐ Does ☑ require IRB approval

I have submitted/will submit my protocol to IRB on _____ (date)

I already have IRB approval 3/8/2019 (date obtained) Protocol # R18020701

Does not ☑ Does ☐ require IACUC approval

I have submitted/will submit my protocol to IACUC on _____ (date)

I already have IACUC approval _____ (date obtained) Protocol # _____

I understand that, if IRB or IACUC approval is needed, data collection or experimentation may not begin until my protocol has been approved.

Student Signature: Jessica Runnels Date: 4/2/19

Advisor Signature: Mark D. Huff Date: 4/2/19